



US009320442B2

(12) **United States Patent**  
**Kapoor**

(10) **Patent No.:** **US 9,320,442 B2**  
(45) **Date of Patent:** **Apr. 26, 2016**

(54) **BIOMETRIC FRONT-END RECORDER SYSTEM**

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(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 286 days.

(21) Appl. No.: **13/573,944**

(22) Filed: **Oct. 15, 2012**

(65) **Prior Publication Data**

US 2013/0116584 A1 May 9, 2013

**Related U.S. Application Data**

(60) Provisional application No. 61/627,768, filed on Oct. 17, 2011.

(51) **Int. Cl.**

**A61B 5/02** (2006.01)  
**A61B 7/04** (2006.01)  
**A61B 5/0452** (2006.01)  
**A61B 5/0205** (2006.01)  
**A61B 5/0408** (2006.01)  
**A61B 7/00** (2006.01)  
**A61B 5/113** (2006.01)

(52) **U.S. Cl.**

CPC ..... **A61B 5/02** (2013.01); **A61B 5/02055** (2013.01); **A61B 5/0452** (2013.01); **A61B 5/04085** (2013.01); **A61B 7/00** (2013.01); **A61B 7/04** (2013.01); **A61B 5/1135** (2013.01); **A61B 2560/0443** (2013.01)

(58) **Field of Classification Search**

CPC ..... A61B 7/04; A61B 5/02; A61B 5/0452; A61B 5/044; A61B 5/0006

USPC ..... 600/513, 523, 528; 381/67  
See application file for complete search history.

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

4,071,694	A *	1/1978	Pfeiffer	381/67
4,991,581	A *	2/1991	Andries	600/528
6,002,777	A *	12/1999	Grasfield et al.	381/67
6,757,392	B1 *	6/2004	Granzotto et al.	381/67
6,884,218	B2 *	4/2005	Olson	600/450
8,092,396	B2 *	1/2012	Bagha et al.	600/586
2001/0030077	A1 *	10/2001	Watson	181/131
2002/0071570	A1 *	6/2002	Cohen et al.	381/67
2002/0111777	A1 *	8/2002	David	702/189
2003/0002685	A1 *	1/2003	Werblud	381/67
2004/0076303	A1 *	4/2004	Vyshedskiy et al.	381/67
2004/0220487	A1 *	11/2004	Vyshedskiy et al.	600/513
2006/0025696	A1 *	2/2006	Kurzweil et al.	600/509
2009/0316925	A1 *	12/2009	Eisenfeld et al.	381/67
2010/0274099	A1 *	10/2010	Telfort et al.	600/300

\* cited by examiner

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(57) **ABSTRACT**

A stethoscope front-end recorder device (also referred to as Sleeve) for the chest piece of a stethoscope, which is easily installed and removed. The Sleeve covers the circumference of the chest piece of a stethoscope. The Sleeve contains sensors for acquiring biosensor parameters such as electrocardiogram, body temperature, heartbeat, heart rhythm, heart rate variability, heart rate turbulence, heart sounds, respiration, cardiac index and blood flow. The Sleeve has Bluetooth interface communicating with a mobile device with software component, interfacing with a back-end server with the capability to capture, analyze and save patient information.

**12 Claims, 17 Drawing Sheets**

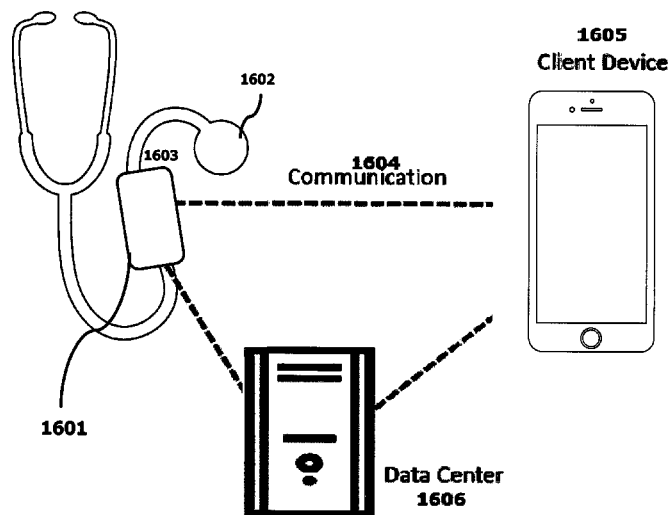


Figure 1

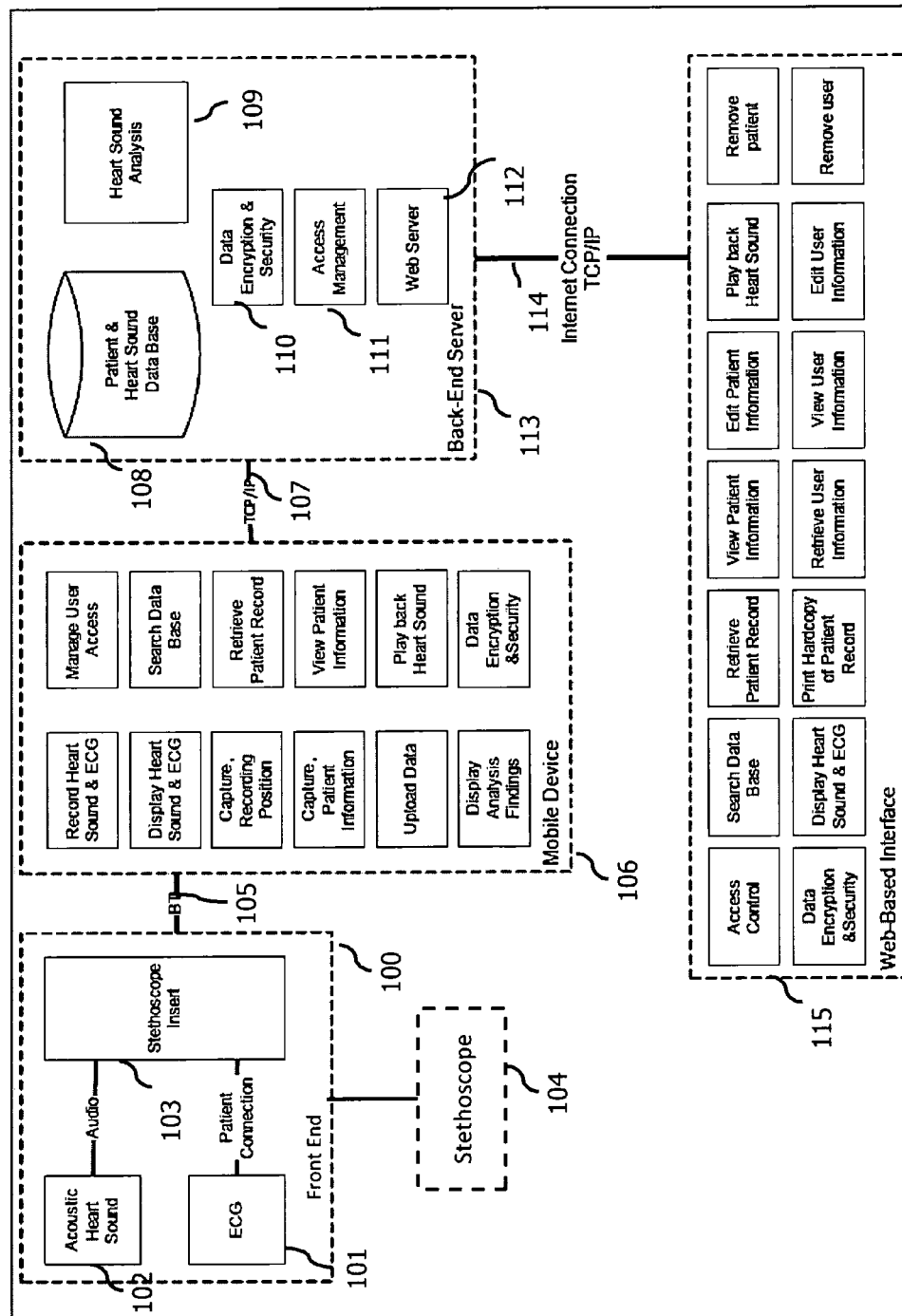


Figure 2

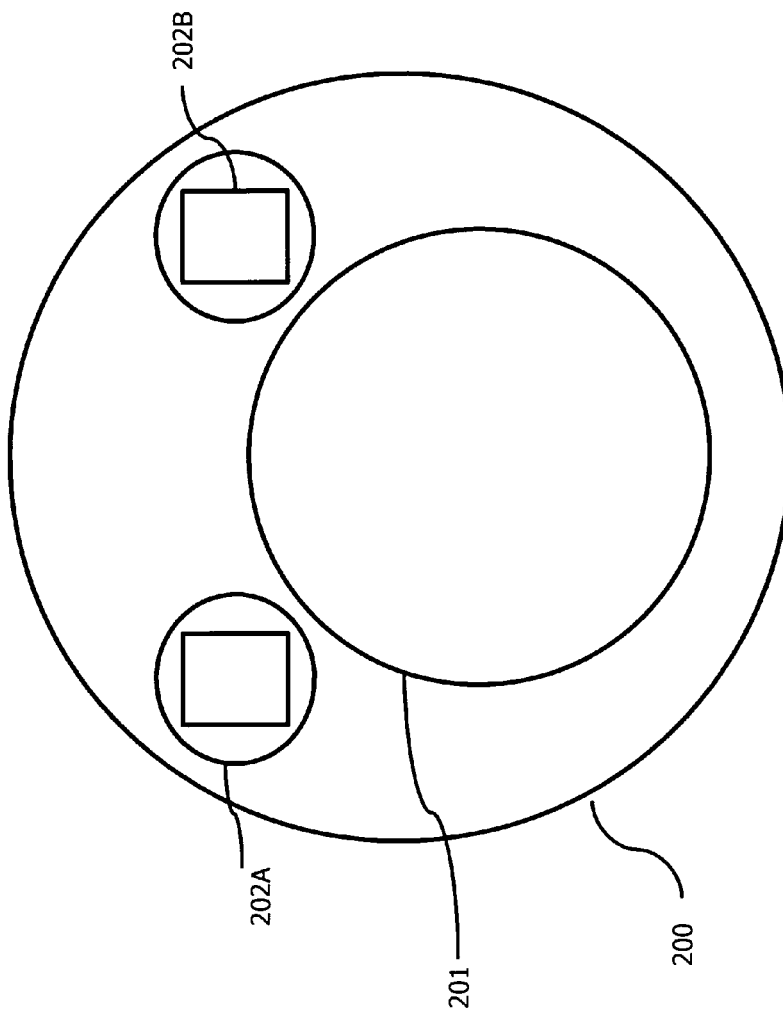


Figure 3

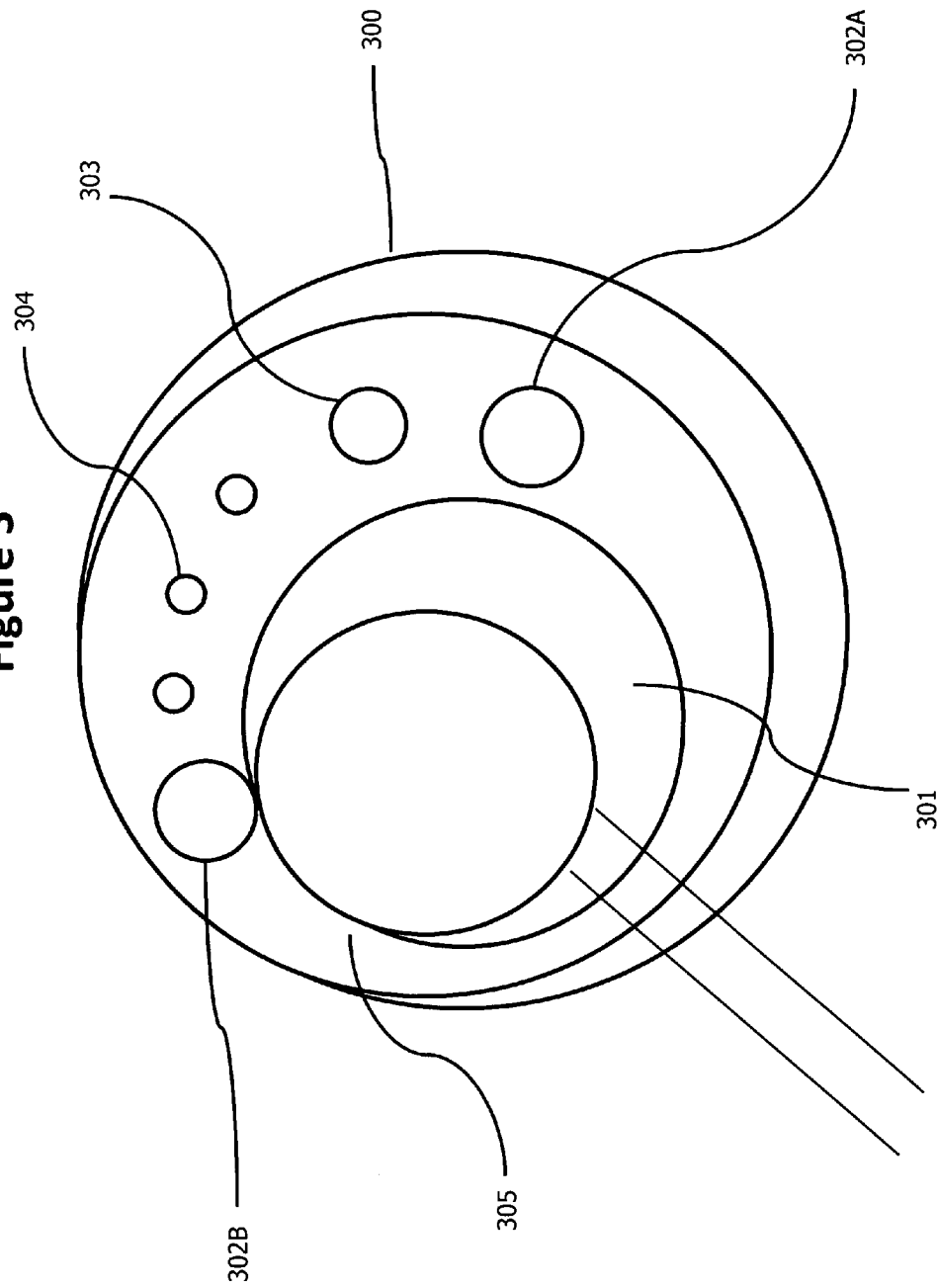


Figure 4

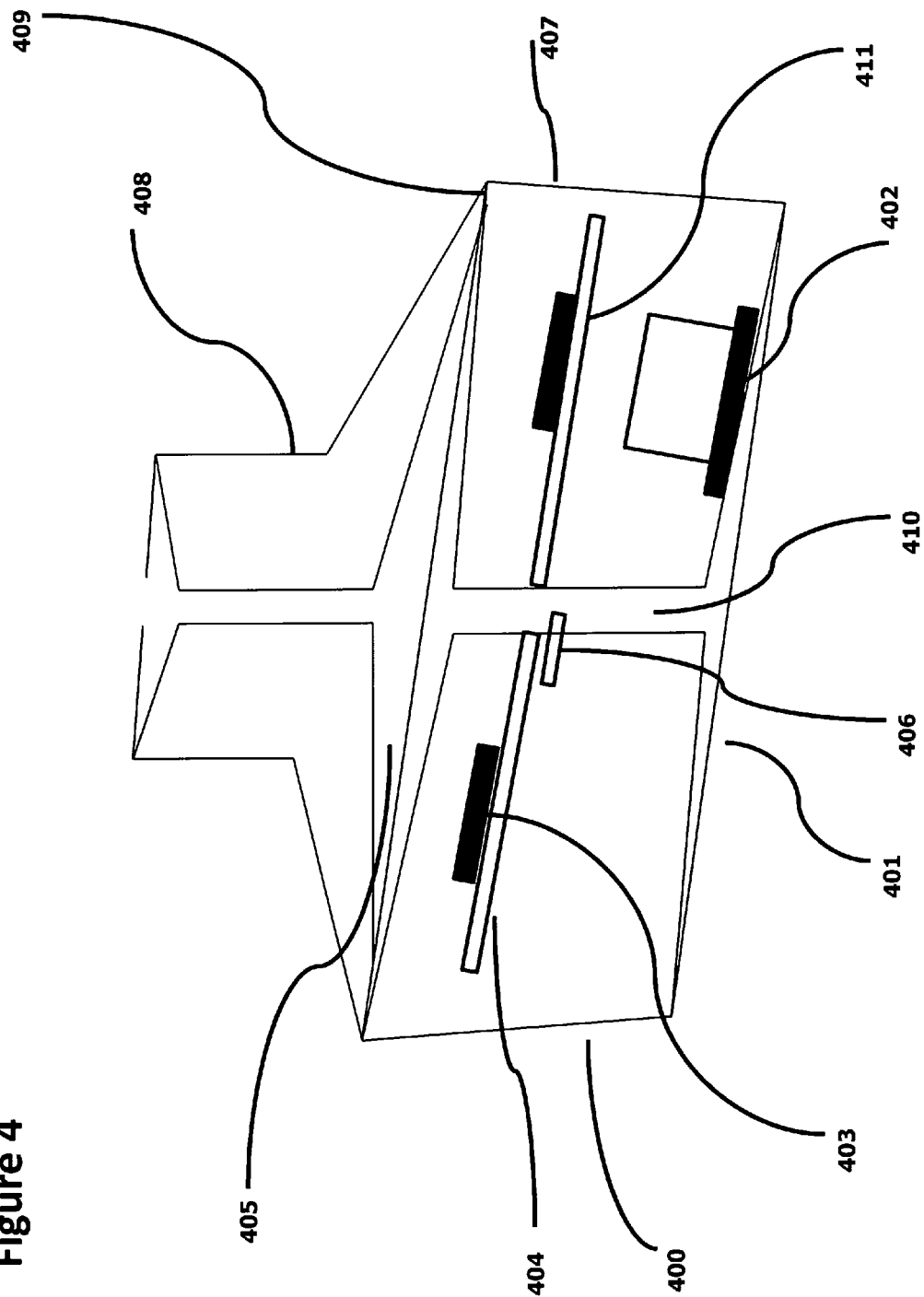


Figure 5

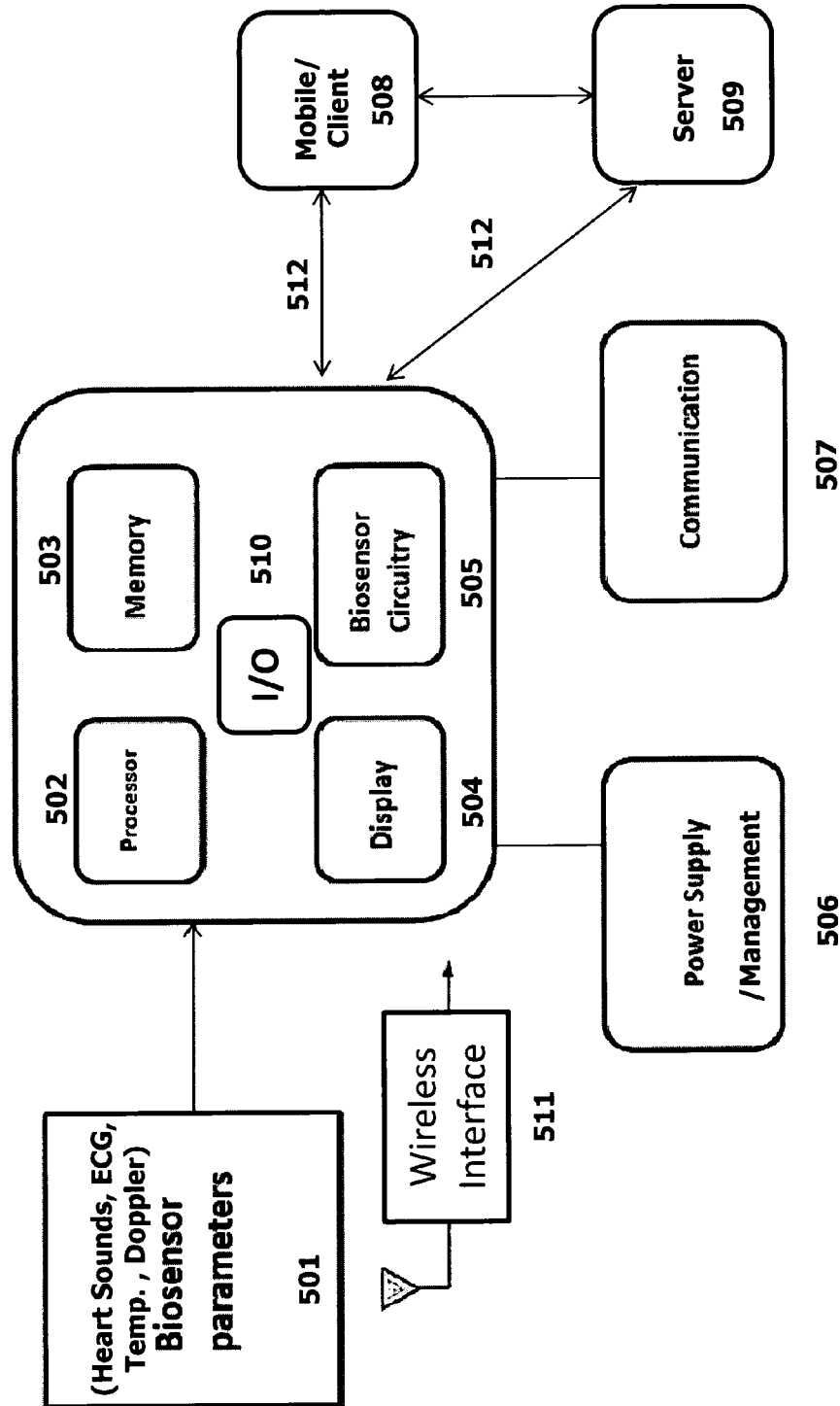


Figure 5A

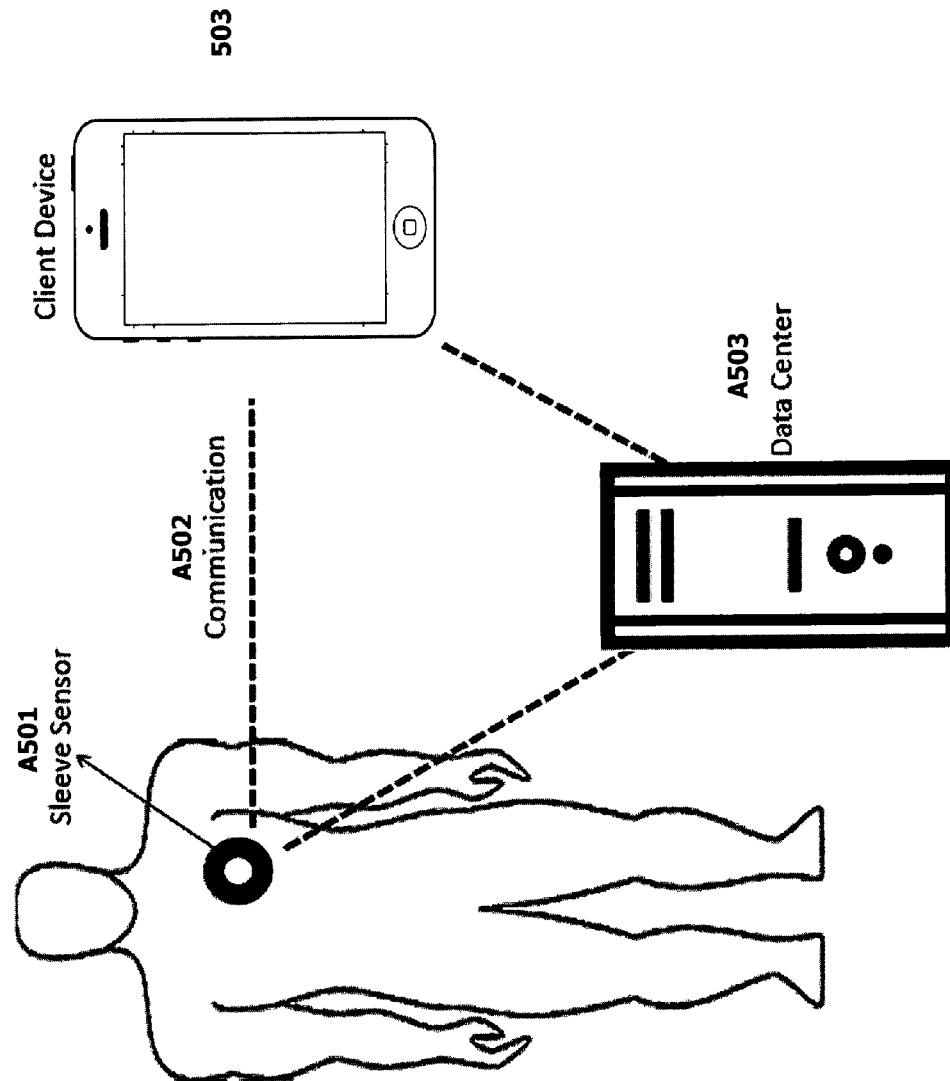


Figure 6

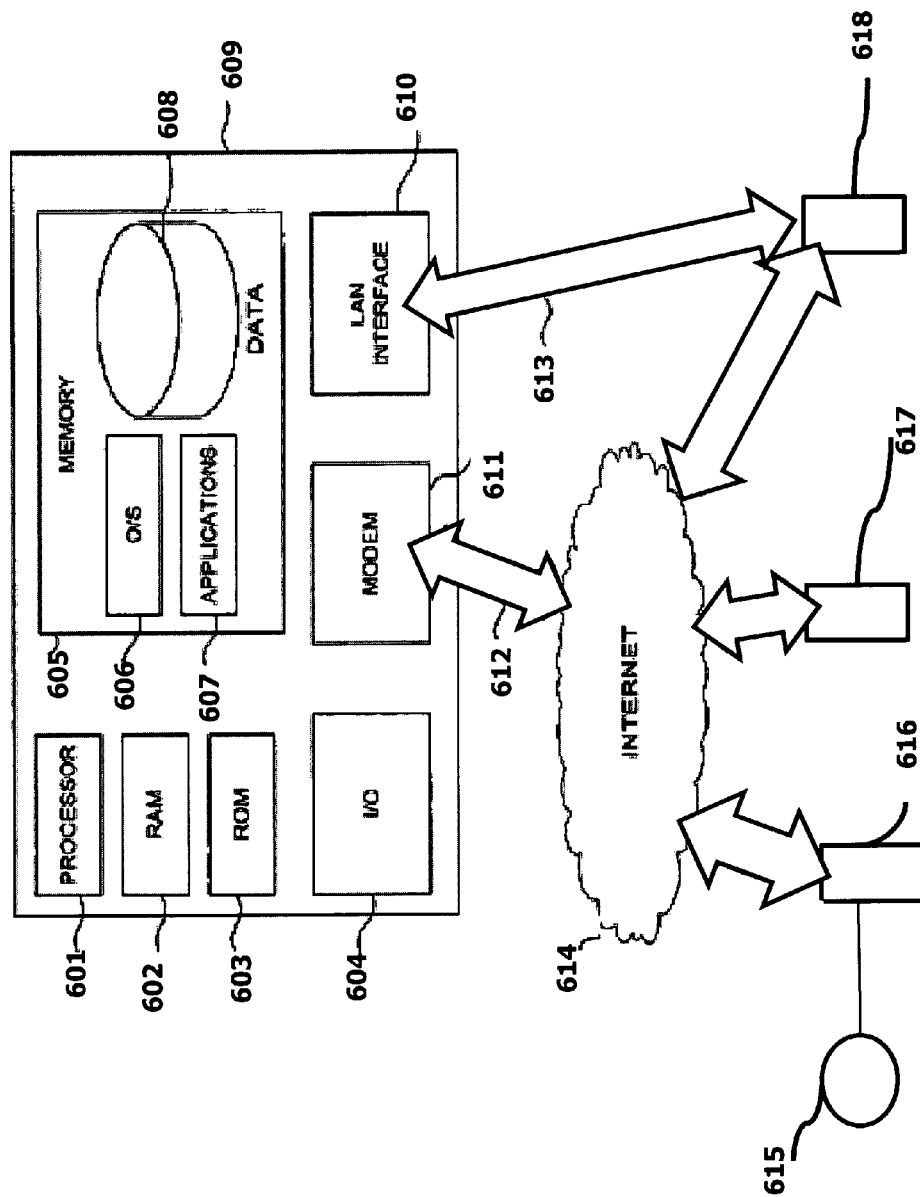




Figure 7

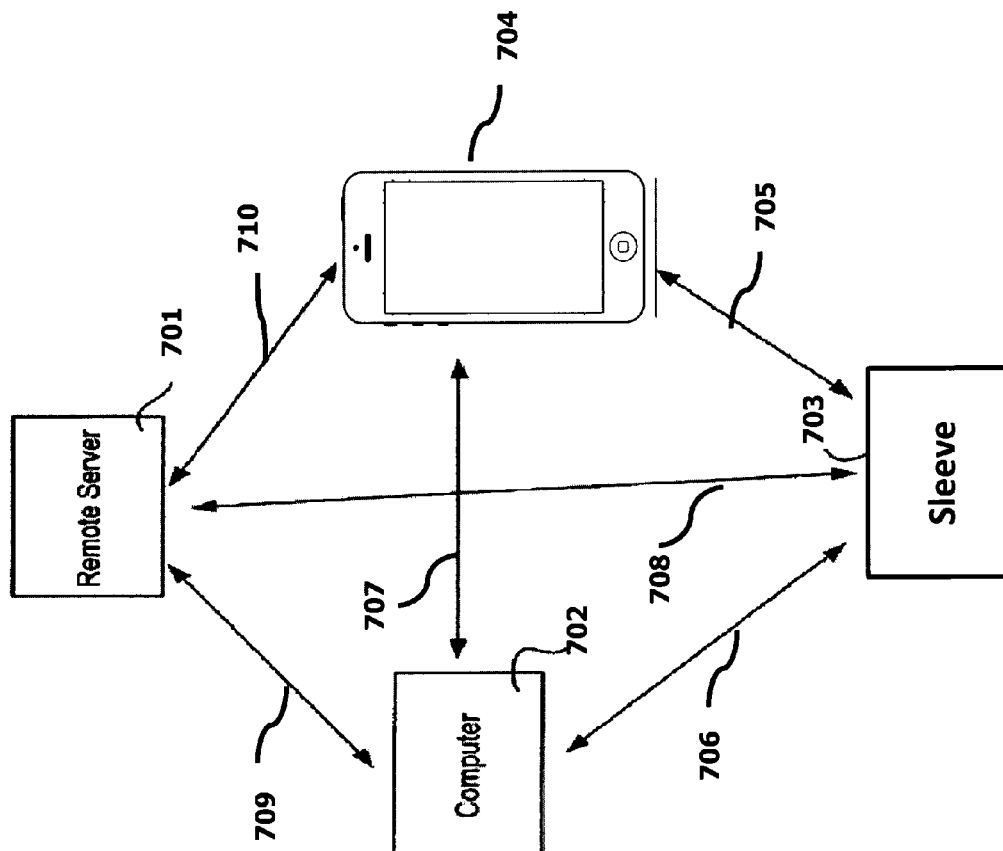


Figure 8

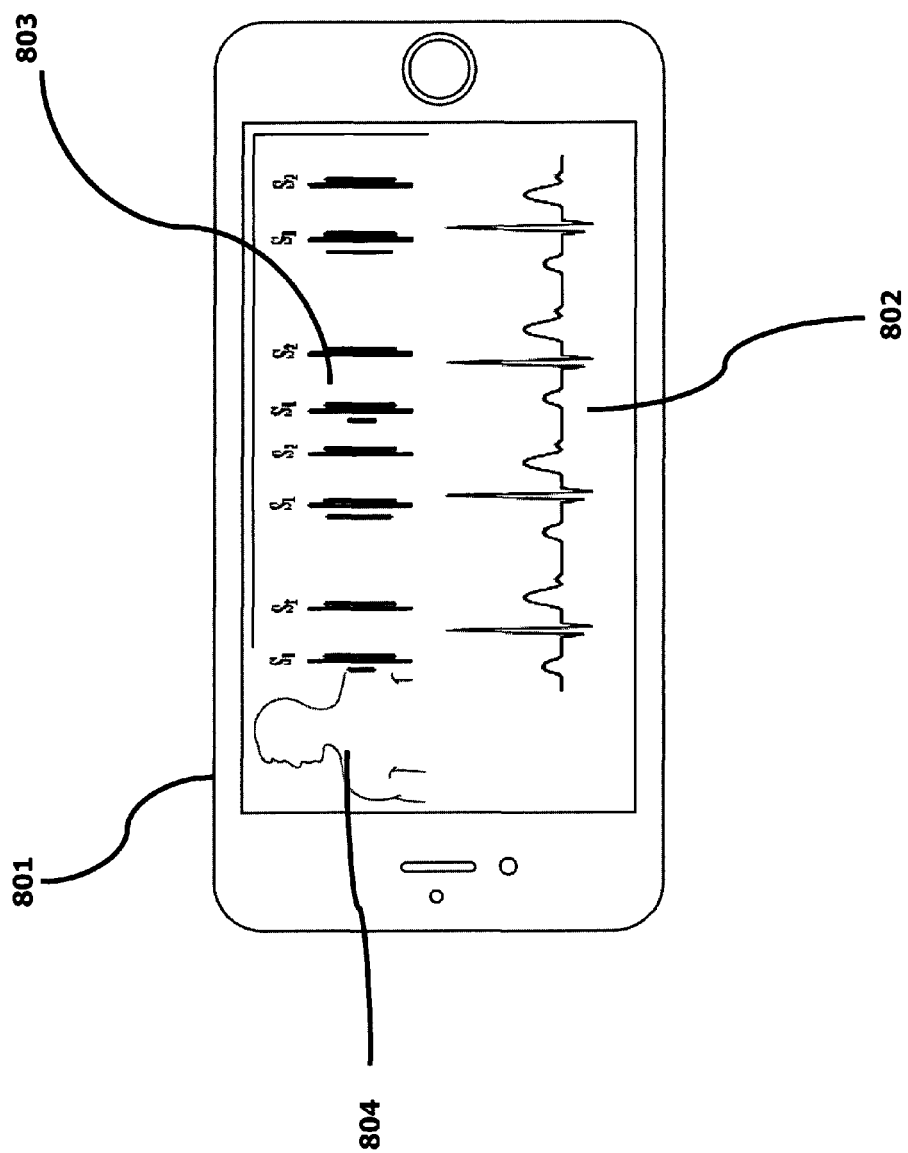


Figure 9

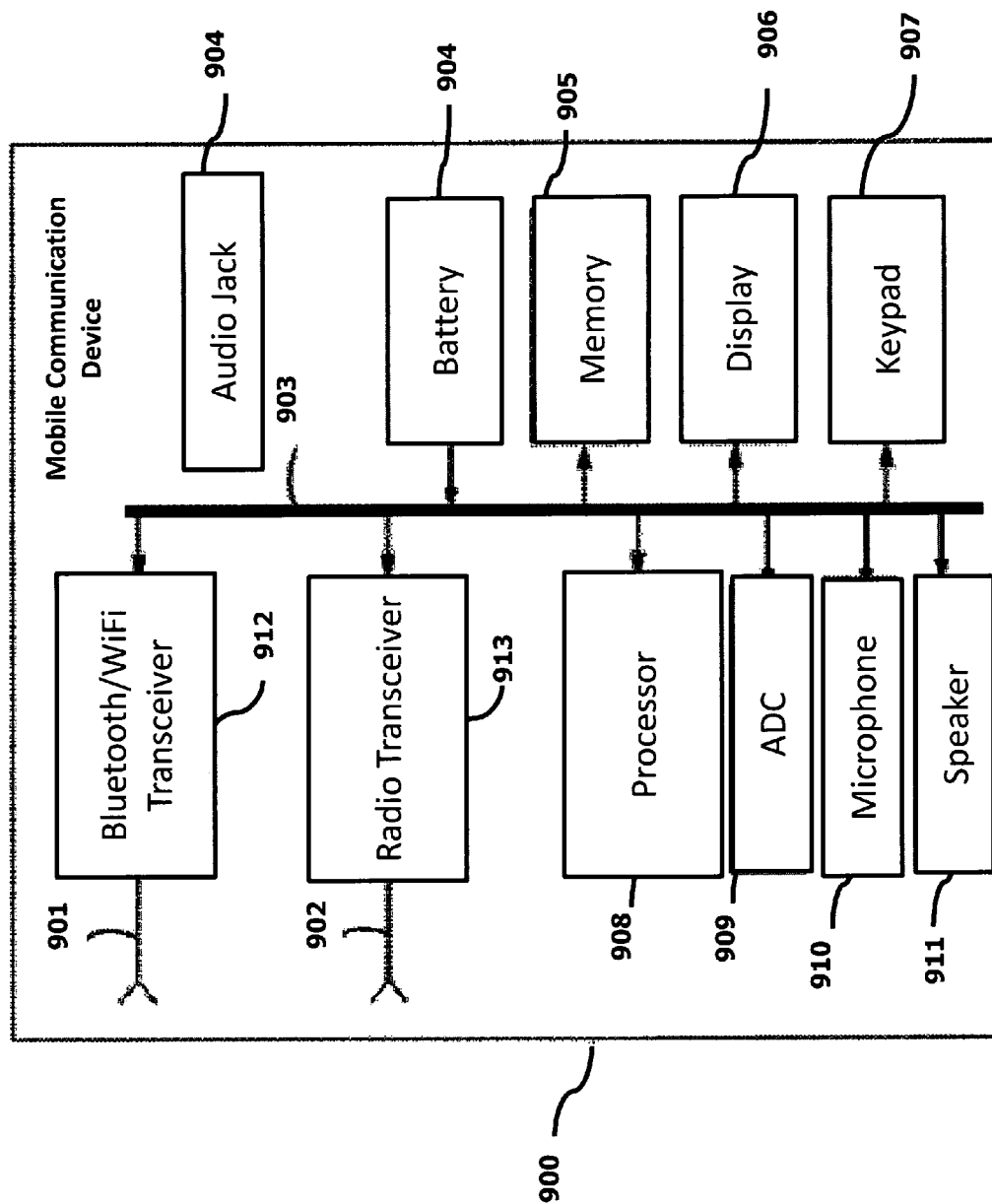


Figure 10

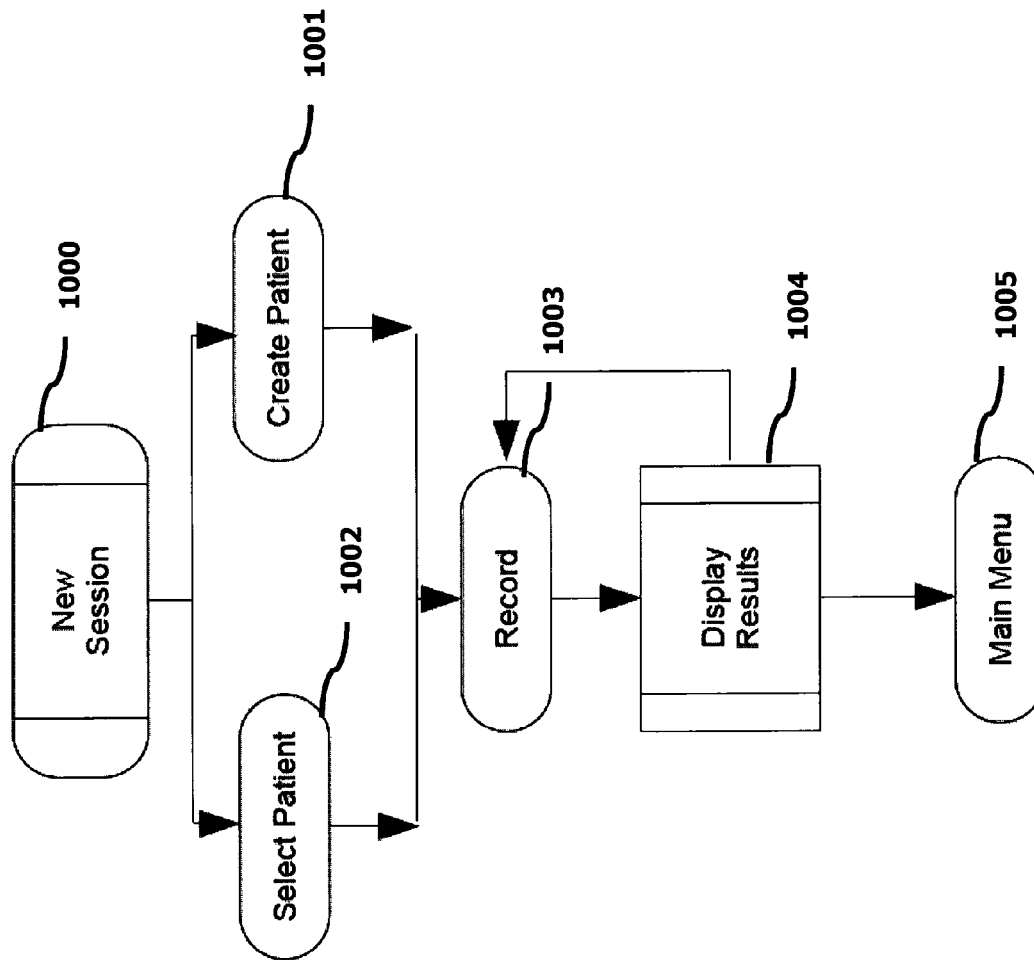


Figure 11

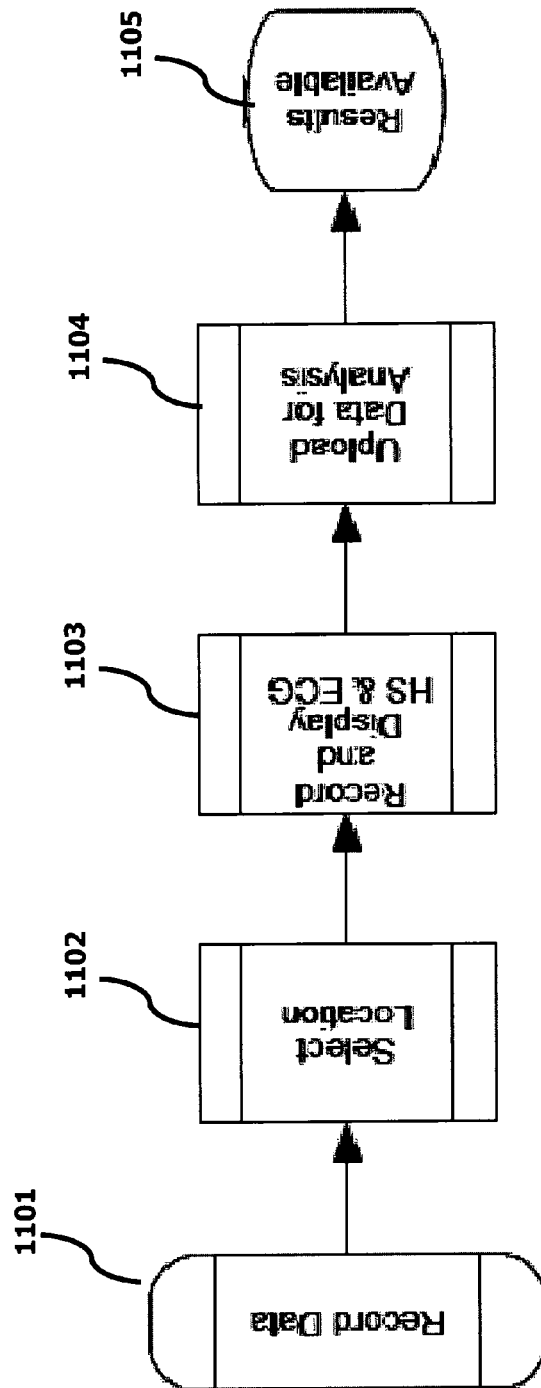


Figure 12

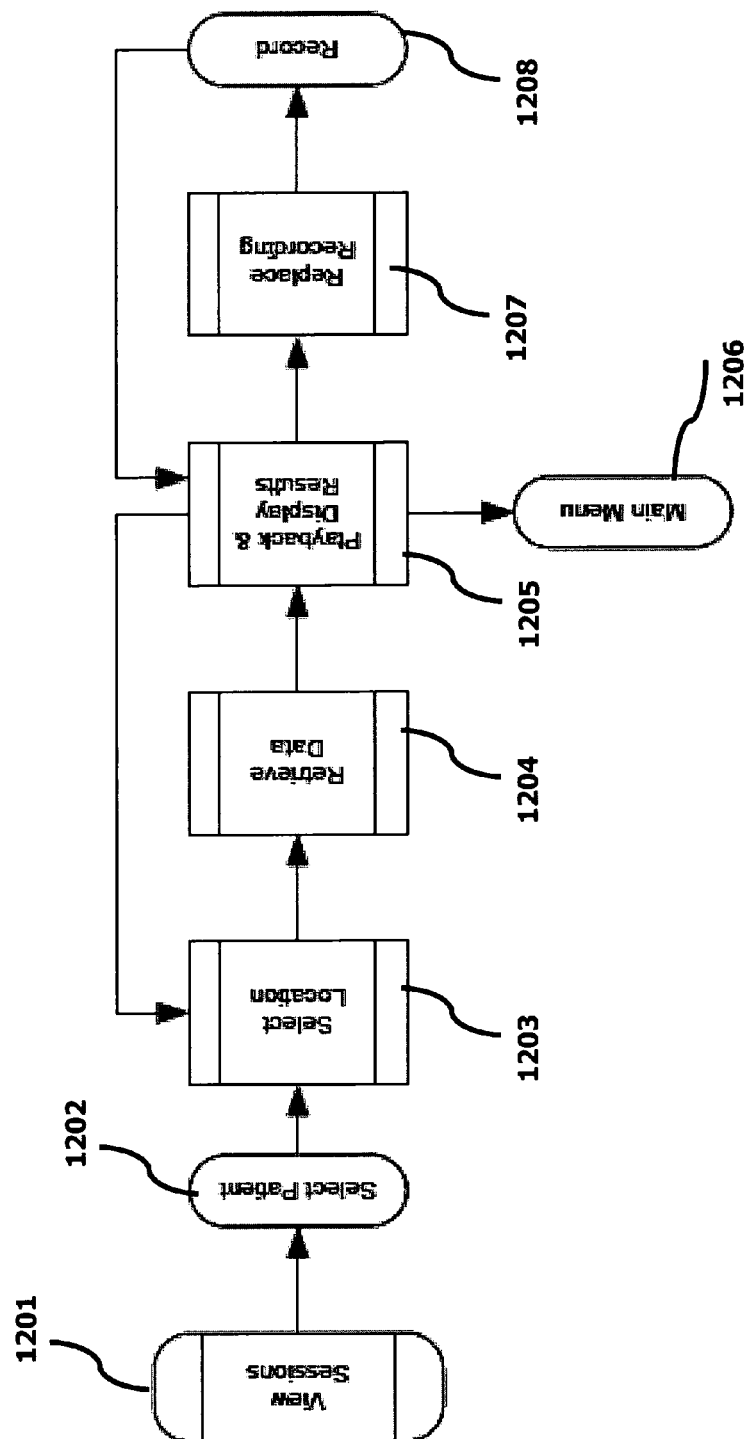


Figure 13

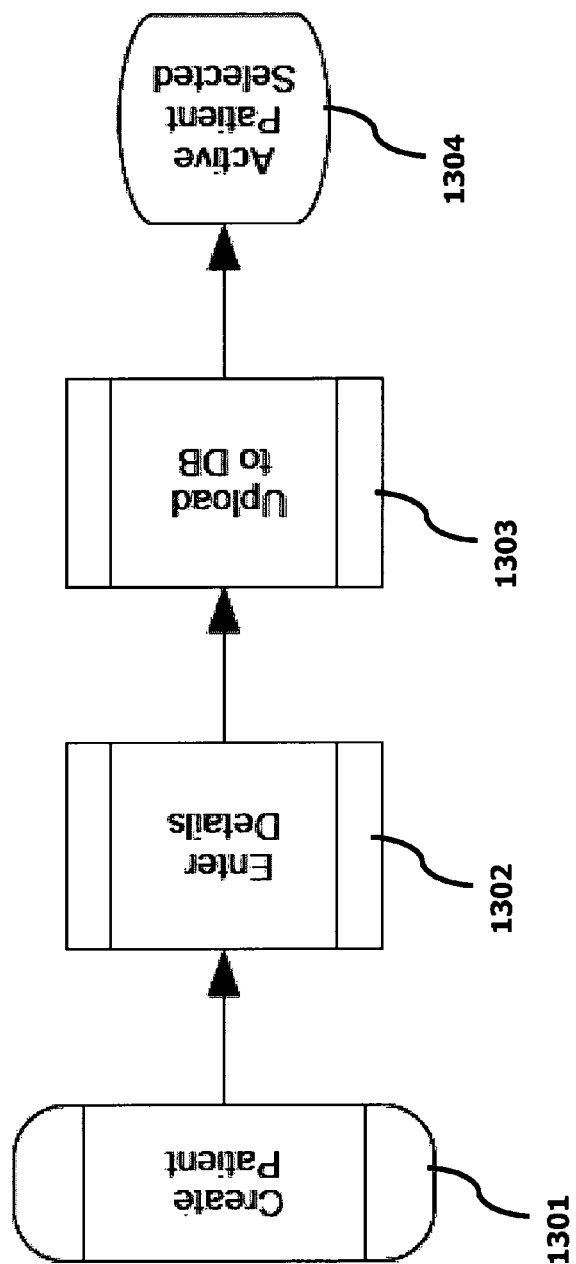


Figure 14

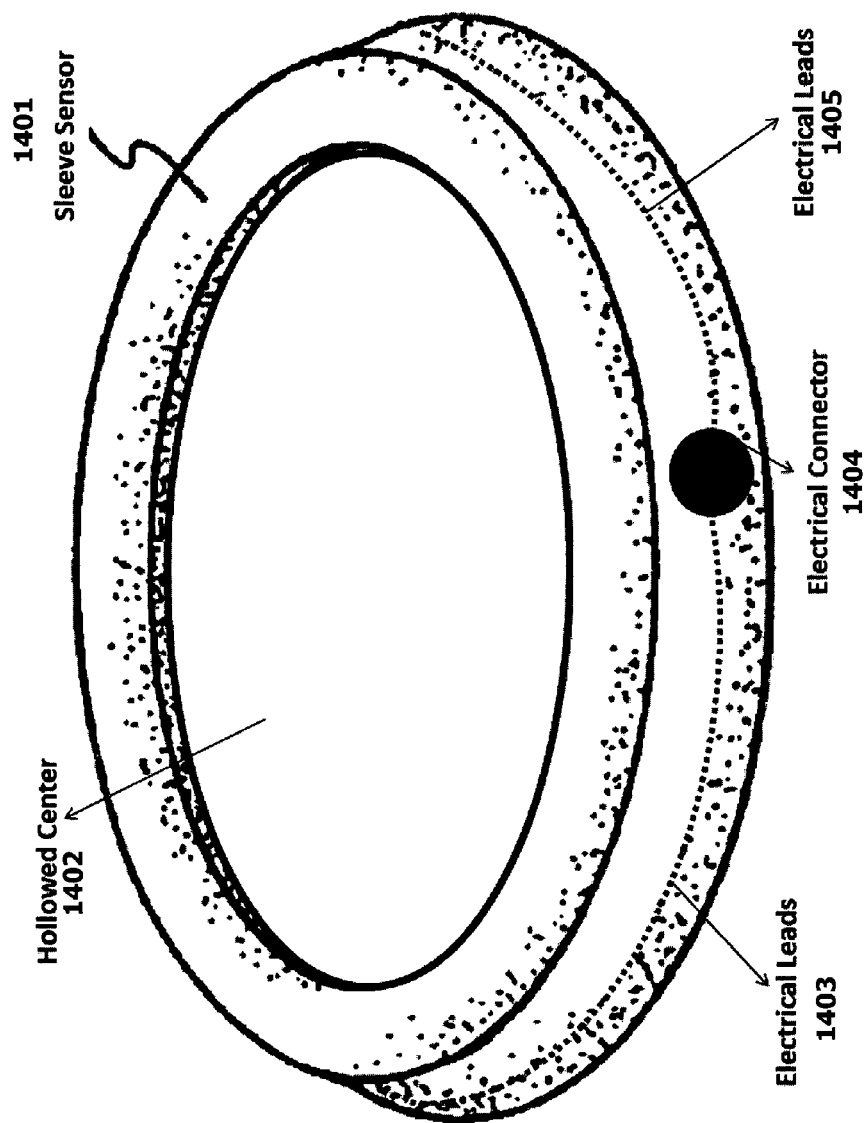
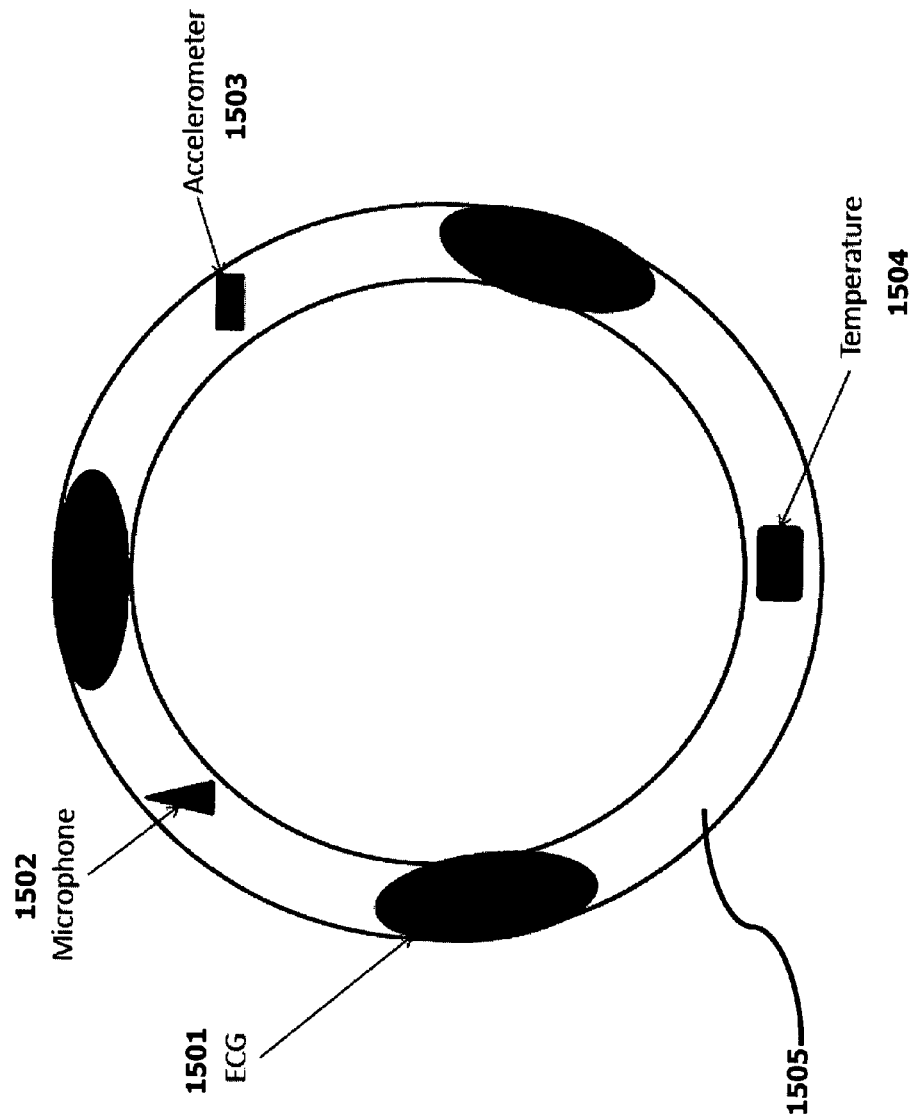
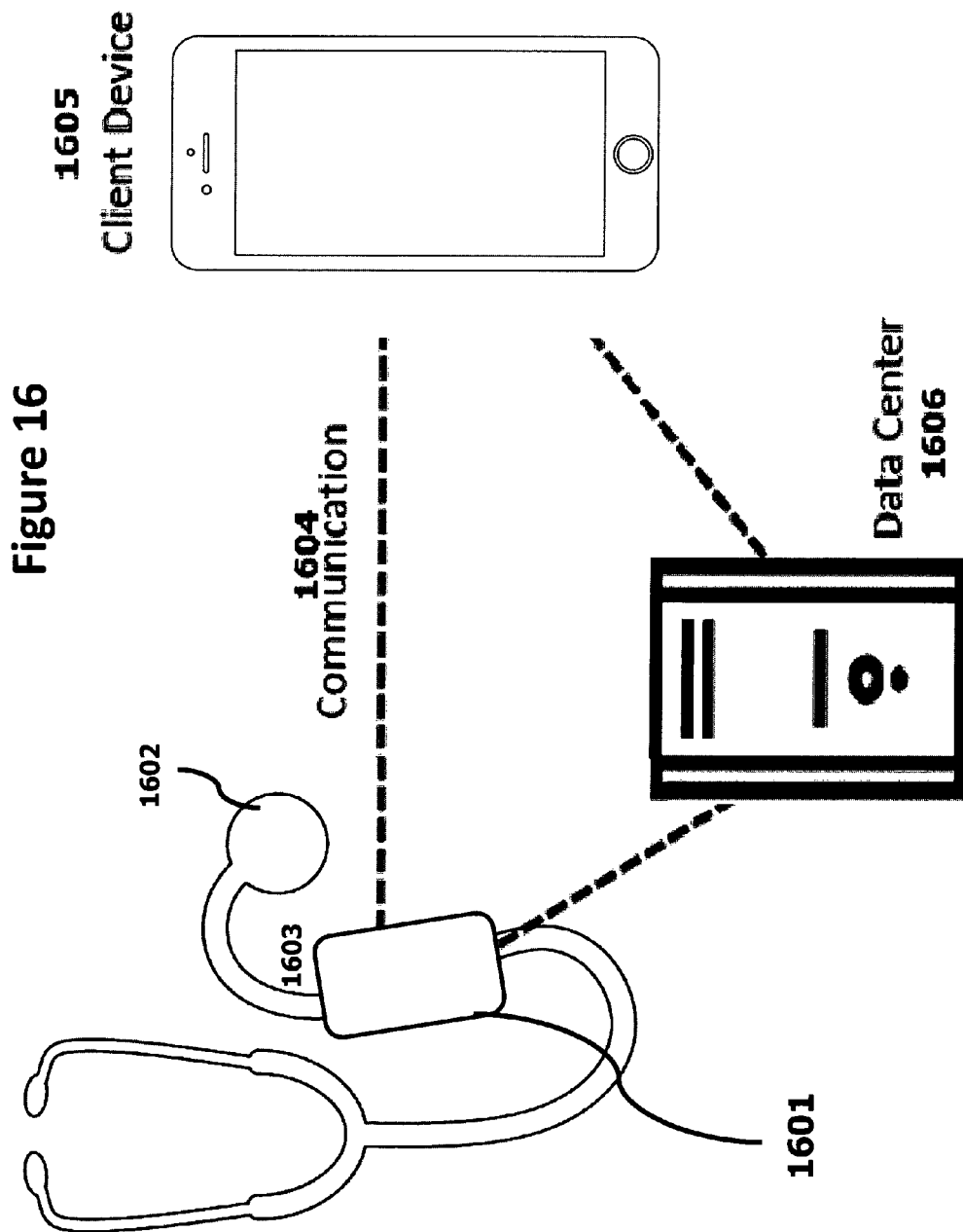




Figure 15





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**BIOMETRIC FRONT-END RECORDER  
SYSTEM****REFERENCE TO CO-PENDING  
APPLICATION(S)**

The present application is a continuation of U.S. Provisional Patent Application Ser. No. 61/627,768, filed on Oct. 17, 2011, the entire disclosure of which is hereby incorporated by reference.

**TECHNICAL FIELD**

The present invention relates to medical devices, and more particularly, to a sleeve for the chest piece of a stethoscope, which is easily installed and removed.

**BACKGROUND OF THE PRIOR ART**

The heart and body produce hundreds of specific sounds, including heart, lung, bowel, circulatory and Korotkoff sounds. These sounds and combinations thereof are indicative of normal and abnormal conditions. Knowledge of these sounds provides valuable diagnostic information to the physician. The art of listening to these sounds and using them as diagnostic aids is known as auscultation. Early human beings have been able to listen to these sounds by placing the ear to the chest or back of the patient. Later, the air column stethoscope was developed. The stethoscope has proven to be a valuable instrument for medical professionals. The standard air column stethoscope used by the medical profession employs a listening cup placed on the chest or back of the patient with the sound amplified by a simple bell and diaphragm into a standing air column terminating in earpieces for the physician's ears.

The conventional stethoscope has remained relatively unchanged since the last century. Many problems exist with the use of conventional stethoscopes. In general, conventional stethoscopes offer very subjective information. For example, the hearing capability of the user has direct impact on the sounds observed. When a loud sound is followed by a soft sound, difficulty exists in detecting and assessing the intensity of the soft sound. It is difficult to time an abnormal heart sound with respect to the phase of the heartbeat, an important aspect of murmur diagnosis. A fast beating heart can make both the recognition and timing of abnormal sounds difficult. This problem is often found with children and animals where heart rates are often much higher than in adult humans. External noise may often mask heart, lung, circulatory and Korotkoff sounds detected under non-ideal listening conditions. These and many other problems plague the conventional stethoscope.

In response, the field has developed electronic stethoscopes that detect and display as waveforms both audio (heart sound) and ECG (heart electrical activity), as well as presenting the heart sounds aurally. Little et al. (U.S. Pat. No. 4,362,164) describe a stethoscope having a detector head that includes a microphone and is selectively connectable to either a conventional chest-bell or an electrode chest-bell. The electrode chest-bell is adapted to pick-up electric heart signals, and the microphone to pick up body sounds. The electrode and microphone signals are sent to a separate monitoring unit to display both ECG and phonocardiographic waveforms. The conventionally detected body sounds are transmitted via air column tube directly to the user's ears. However, the Little device, and others like it, require connectivity (either via interconnect cable or wireless transmission) between the

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stethoscope and a separate display unit, and they are not easily transported about a physician's or other care staffs person. Again, although these devices also may be useful for their intended purpose, they too have their limitations.

Most efforts at visual display of heart data have been directed to the electrocardiographic wave pattern. Because the electrocardiographic wave pattern, i.e., the electrical wave pattern generated by the heart, is more easily processed and displayed, the electronic monitoring, displaying and storing of the electrocardiographic wave pattern has been addressed. Many patents deal with the detection, storage and display of the electrocardiographic wave pattern. Early efforts to visually display heart data were disclosed by Vogelman in U.S. Pat. No. 3,921,624. Shimoni in U.S. Pat. No. 4,617,938 and Citron in U.S. Pat. No. 4,417,306 disclosed systems for acquiring and recording electrocardiographic wave patterns. Further, Lisiecki disclosed a transfer of the recorded signals to a fixed computer for visual display. Anderson in U.S. Pat. No. 4,628,327 disclosed the acquisition, digitalization and storage of electrocardiographic wave patterns in a circular memory. Upon tripping of an alarm indicating a preset abnormal condition, the attached recorder rapidly produces a visual output of the stored data both before and after the event which tripped the alarm. Yoneda in U.S. Pat. No. 4,779,199 similarly disclosed acquisition and digitalization of the electrocardiographic wave pattern. Further, U.S. Pat. No. 4,115,864 and U.S. Pat. No. R 29,921 both disclosed the acquisition and storage of electrocardiographic wave pattern data followed by a display of that data with previously recorded electrocardiographic wave patterns to permit a visual comparison of the results by the physician.

As the above patents illustrate, most efforts at electronic storage and display of heart data have been directed to the electrocardiographic wave pattern. This is because the ECG wave pattern is much simpler and at a significantly lower frequency than the phonocardiographic heart sounds. Detection, digitization, storage and display of the phonocardiographic heart sounds are complicated by the presence of many other body sounds and by their higher frequency and more variable wave pattern. However, some work has been done in this area. Slavin in U.S. Pat. No. 4,483,346 disclosed a portable device for recording both an electrocardiographic wave pattern and phonocardiographic sounds. The phonocardiographic sounds were digitalized and stored for later transmission through a modem to a computer for storage and display. In U.S. Pat. No. 4,624,263, Slavin added cassette storage capability to the previously disclosed portable recorder. Further, Slavin disclosed the storage of abnormal phonocardiographic information for displaying with the patient's heart sounds to illustrate differences.

Although these devices may be useful for their intended purposes and may overcome some of the limitations of the classic air column stethoscope's dependence on the inherent energy contained in the original body sound, they do not address the issue that aural auscultation alone may not be sufficient to perform an adequate diagnosis, particularly of heart condition and are integrated into the chest piece or converting the conventional stethoscope into an electronic stethoscope.

Therefore, it would be beneficial to have a versatile accessory to the conventional stethoscope that is easily portable, and has the capability to monitor and display at least heart sounds and heart electrical activity, as well as preserving the usual auscultation purposes of the conventional stethoscope.

**BRIEF SUMMARY OF THE INVENTION**

The present invention is the provision of a stethoscope front-end recorder device (also referred to as Sleeve) for the

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chest piece of a stethoscope, which is easily installed and removed. The Sleeve covers the circumference of the chest piece of a stethoscope. The Sleeve contains sensors for acquiring biosensor parameters such as electrocardiogram (ECG), body temperature, heartbeat, heart rhythm, heart rate variability (HRV), heart rate turbulence (HRT), heart sounds, respiration, cardiac index and blood flow. The Sleeve sensor system may be self-contained and does not require ancillary equipment to be connected or linked to the stethoscope to accomplish its utility.

In one embodiment, the current invention includes A method of determining an acoustic and electrical footprint of the heart comprising: (1) acquiring heart sounds and electrocardiogram, (2) transmitting the heart sound and the electrocardiogram to an acoustic stethoscope, (3) wirelessly transmitting the heart sound and the electrocardiogram to a mobile device, using a processor and wireless module, (4) the mobile device transmitting the heart sound and the electrocardiogram to a remote server, wherein the remote server analyzes both the heart sound and the electrocardiogram and determines cardiac malfunction, (5) transmitting the results to the mobile device and archiving the results after transmission, and (5) displaying on the mobile device the result of the analysis.

The current invention includes a system for determining normal and pathological heart sound comprising: (a) stethoscope front-end recorder device with biological sensors, wherein the front-end recorder device is configured to (a) acquire at least body sounds and electrocardiogram signals, (b) transmitting the at least body sounds and electrocardiogram signals to a client device and (c) display data transmission and battery life status.

The invention includes a client device configured to: display at least body sounds and electrocardiogram, enable a user to create or select patients, enable the user to select body sound location and electrocardiogram leads, record and review body sounds, electrocardiogram and cardiac index, transmit body sound and electrocardiogram signals to a remote server.

The invention includes remote server configured to: (1) analyze body sound and electrocardiogram for normal and pathological conditions, (2) authenticate the user, (3) archive body sounds, electrocardiogram and cardiac index.

#### BRIEF DESCRIPTION OF THE DRAWINGS

In the following description embodiments of the object according to the invention is described with the help of the attached drawings.

FIG. 1 illustrates a block diagram of the system and its components

FIG. 2 illustrates the bottom view of the Sleeve

FIG. 3 illustrates a top view of the Sleeve

FIG. 4 illustrates a cross section of the Sleeve

FIG. 5 illustrates a block diagram of the electrical components

FIG. 5A Illustrates an interaction between a self-contained Sleeve, Mobile device and server

FIG. 6 Illustrates Server, Network, Client Devices and Sleeve interaction

FIG. 7 illustrates how the devices are connected to each other

FIG. 8 illustrates a mobile client device

FIG. 9 illustrates a block diagram of the mobile client device

FIG. 10 illustrates a new session creation

FIG. 11 illustrates a recording session

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FIG. 12 illustrates viewing of recorded results

FIG. 13 illustrates the creation of new patients

FIG. 14 illustrates an alternative ring Sleeve

FIG. 15 illustrates the alternative ring Sleeve with Sensors

FIG. 16 illustrates the alternative ring Sleeve with alternative enclosure box

#### DETAILED DESCRIPTION

The inventive system, in accordance to FIG. 1, consists of a stethoscope front-end recorder device **100** (also referred to as stethoscope recorder device or Sleeve) with a Bluetooth interface **105** connected to a standard acoustic stethoscope **104**, a mobile device **106** with software component running on it, interfacing the stethoscope recorder device and a back-end server **113**, with the capability to capture and save patient information to the backend server **113**, as well as receiving analysis results and accessing stored patient information from the back-end server **113**. A data processing unit on a back-end server **113** analyzes **109** the heart sound and ECG signal for pathological murmurs or only recording the ECG signal. The backend server **113** contains an encrypted database **108** for storing patient information. It also contains a web-server **112** and interface **115** for a user(s) to securely access patient data.

The sleeve interfaces with an acoustic stethoscope **114** and records both the acoustic heart sound **102** and/or ECG signals **101**. In a preferred embodiment, those signals are sent via Bluetooth wireless communication protocol **105** to a mobile device **106**. The sleeve can also with the mobile device via wireless local area network (WLAN) products that are based on the Institute of Electrical and Electronics Engineers' (IEEE) 802.11 standards such as Wi-Fi. It can also use cellular network or mobile network. When the device's integral electrodes are placed on the chest of the patient, it is capable of verifying, measuring, storing and transmitting to a database the cardiac bio-potential activity.

By using a cellular telephone or other client devices on which customized Sleeve software is installed to review physiologic data of a patient and to (a) view the near real-time waveforms remotely (b) remotely review other standard patient data. The Sleeve software can display at least the following physiologic data captured by the front-end recorder device:

- a) ECG Waveform
- b) Auscultation Waveform
- c) Cardiac Index
- d) Systolic Blood Pressure Cuff
- e) Diastolic Blood Pressure Cuff

Referring to FIG. 3, the sleeve **300** covers the circumference or the outer edge of a conventional stethoscope **301** applied to the diaphragm of stethoscope **405** of FIG. 4. The sleeve **300** is held in place on the chest piece of the stethoscope by a flexible, stretchable skirt **305** extending to the edge the circumference of the stethoscope's bell **301**. The sleeve has a thickness of at least 0.5 inch. The circumference of the sleeve contains at least 2 ECG electrodes obtaining **202A** and **202B** of FIG. 2 signals and a diaphragm **201**. The ECG electrodes enable the user record ECG Lead I, Lead II and Lead III, by rotating the negative and positive electrodes around the patient's chest, using einthoven's triangle vector theory, similar to what taught in U.S. Pat. No. 6,884,218 (incorporated by reference).

Referring to FIG. 4, the sleeve **400** contains printed circuit board, or PCB **404** and an optional display module (not shown) in an enclosure box **400**. The PCB **404** contains electronics circuitry that comprises a processor **403** and the corresponding circuitries for biosensor parameters **501** of

FIG. 5. Referring to FIG. 5, the PCB contains a computer processing unit (CPU) 502 with memory 503, an input/output (I/O) circuit 510, and an optional view screen 504. A power supply 506 is in operative communication with the circuits of the display and processing modules to provide electrical power as needed. The electric signal inputs from the sensors (e.g., ECG, temperature, and microphone) are inputted via the electrode connector of the sensor sleeve. The sensor circuitries further condition and digitize the biosensors parameters from the sensor sleeve. The digitized signals are then conducted under the control of the CPU and memory circuits to the view screen display for visual display, or to the I/O and communication ports for export from the PCDM to client devices (e.g., mobile, pc or remote server, printers, data storage devices, signal display equipment and other devices). The Sleeve contains light-emitting diodes 304 of FIG. 3 (LEDs) as indicators to communicate different modes such as on/off, data transfer, and battery indicator. The Sleeve also includes a power switch 303, and negative/positive indicators 302A and 302B. The Sleeve also contains 2.5 mm headphone port for output body sounds to headphone or speakers. Alternatively, the captured heart or body sound may be output to a speaker or sound exciter, used to enhance the sound signal going to stethoscope.

In a preferred embodiment, the power supply is a rechargeable power supply, and more particularly, a rechargeable battery 402 of FIG. 4 power supply. In the preferred embodiment, the battery or batteries of the power supply is rechargeable lithium polymer battery.

The CPU processor comprises a tangible medium, for example read only memory (ROM), electrically erasable programmable read only memory (EEPROM) and/or random access memory (RAM). The processor may comprise many known processors with real time clock and frequency generator circuitry, for example the PIC series of processors available from Microchip, of Chandler Ariz. In some embodiments, processor may comprise the frequency generator and real time clock.

The processor can be configured to control a collection and transmission of data from the ECG, microphone, accelerometer and temperature circuitries. In another embodiment, the processor may be configured to collect data from a pressure transducer for nasal airflow. In other embodiments, the processor may be configured to collect data from a blood pressure monitor, pulse oximeter, electromyogram (EMG), Doppler and ultrasound.

The PCB 404 also comprises of wireless communication circuitry 511 of FIG. 5, communication module coupled to the processor system to transmit the biosensor parameters to client devices 508 (mobile or personal computer) or remote server 509 with a communication protocol 512. The communication protocol may comprise at least one of Bluetooth, Zigbee, WiFi, WiMax, IR, a cellular protocol, amplitude modulation or frequency modulation. The client devices may comprise a data collection, analysis and display systems to collect and/or store data from the wireless transmitter and wherein the data collection system is configured to communicate periodically with the remote center and the Sleeve with wireless connection and/or wired communication. In some embodiments, the sleeve sensor device may have a rechargeable module, and may use dual battery and/or electronics modules, wherein one module can be recharged using a charging station while the other module may be a tiny USB port placed on the sleeve sensor.

Referring to FIG. 5A, in another embodiment, the sensor sleeve A501 may be self-contained unit affixed and/or adhered to the body of the patient or user. For example, the

sensor sleeve may be affixed and/or adhered to the body with at least one of the following: an adhesive tape, suspenders around shoulders, a pre-shaped electronics module to shape fabric to a thorax, a pinch onto roll of skin, or transcutaneous anchoring. The sleeve sensor may also adhere to the body via a chest strap, and/or a low-irritation adhesive for sensitive skin. In addition to having a circular shape, the sensor device can be comprised of many shapes, for example at least one of an hourglass, an oblong, a circular or an oval shape. The sleeve sensor may comprise a reusable electronics FIG. 5 module with replaceable cover, and each of the replaceable covers may include a battery. The sleeve sensor electronics may comprise of a module for collecting biosensor data for approximately at least 1 day, with the capability to wirelessly send data to a client device via Bluetooth, Zigbee, WiFi, WiMax, IR, a cellular protocol, amplitude modulation or frequency modulation or wired via Universal Serial Bus (USB) and proprietary connectors. The entire sleeve sensor and electronics component may be disposable. In some embodiments, the sleeve sensor device may have a rechargeable module, and may use dual battery and/or electronics modules, wherein one module can be recharged using a charging station while the other module may be a tiny USB port placed on the sleeve sensor.

The bottom of the sleeve contains a diaphragm 401 in FIG. 4. When the diaphragm is placed against the patient, the sounds of the body vibrate the plastic disk and acoustic pressure waves are formed. These pressure waves travel up the sound chamber 401, delivering body sounds to the bottom of the user's stethoscope 405, which is attached to the lid of the sleeve 407.

Running on the backend server 113 is heart sound analysis software 109 that assists medical examiners in analyzing cardiac sounds for the identification and classification of suspected murmurs. It is used to distinguish between normal /physiological and pathological heart murmurs by recording the acoustic signal of the heart and the ECG signal simultaneously and analyze these signals. The acoustic heart signal is analyzed to identify specific heart sounds that may be present.

FIG. 6 illustrates a block diagram of a generic computer server 309 that may be used according to an illustrative embodiment of the invention. The computer server 309 may have a processor 601 for controlling overall operation of the server and its associated components, including RAM 602, ROM 603, input/output module 604, and memory 605.

I/O 604 may include a microphone, keypad, touch screen, and/or stylus through which a user of device may provide input, and may also include one or more of a speaker for providing audio output and a video display device for providing textual, audiovisual and/or graphical output. Software may be stored within memory 605 and/or storage to provide instructions to processor 604 for enabling server 609 to perform various functions. For example, memory 605 may store software used by the server 609, such as an operating system 606, application programs 607, and an associated database 608. Alternatively, some or all of server 609 computer executable instructions may be embodied in hardware or firmware (not shown). As described in detail below, the database 608 may provide centralized storage of account information and account holder information for the entire business, allowing interoperability between different elements of the business residing at different physical locations.

According to certain aspects, the server 609 may operate in a networked environment supporting connections to one or more remote devices, such as client devices 616, 617, 618 (cell phone, PC, laptop and tablets) via the internet 614, communicating with the Sleeve 615. The communication

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network in this example may be connected to an Internet router via a Local Area Network (LAN) network **613** or Wide Area Network (WAN) **612**, and may receive electrical power via a supplied AC power adaptor.

Referring to FIGS. **8-9**, the sleeve software application is installed on a mobile device **801**. The software component running on a mobile device, interfaces with the stethoscope recorder device and the back-end server, with the capability to capture and save patient information to a back-end server, as well as receiving analysis results and accessing stored patient information from the back-end server.

In a preferred embodiment, the mobile device **801** interfaces via Bluetooth **105** with the sleeve device to capture the acoustic heart sound and/or ECG signals on a mobile device and manage this connection. The mobile device sequences the recording of the acoustic heart sound and ECG signals at the various recording locations between the Sleeve front-end and mobile device.

FIG. **9** is a block diagram illustrating selected elements of the mobile communication device **900** in accordance with some embodiments. A processor **908** is coupled to a wireless radio transceiver **902**, a display **906**, a keypad **907**, and a memory **905**. The radio transceiver **901** is connected to an antenna **902**, which is an example of an antenna and is adapted to send outgoing voice and data signals and receive incoming voice and data signals over a radio communication channel. The radio communication channel can be a digital radio communication channel (e.g., a cellular channel as provided by a cellular service provider), such as a CDMA or GSM channel such a radio communication channel has the capacity to communicate both voice and data messages using conventional techniques. In some embodiments, the processor **908** also is coupled to a second Wireless transceiver **901** (e.g., a Bluetooth or WiFi transceiver), connected to a corresponding antenna **902**, for communicating with the Sleeve or server.

The processor **908** has the capability to perform not only the radio communication services necessary to allow for phone and data communications (e.g., via the transceivers **901** and/or **902**), but also to execute various application programs that are stored in the memory **905**. These application programs can receive inputs from the user via the display **906** and/or keypad **907**. In some embodiments, application programs stored in the memory **905** and run on the processor **908** are, for example, iPhone, Android, Windows Mobile, BREW, J2ME, or other mobile applications and can encompass a broad array of application types. Examples of these applications include medical applications games, and multimedia applications. Medical applications can include the Sleeve's decision support software package to assist the medical examiner during heart auscultation to distinguish between normal/physiological and pathological heart murmurs by recording the acoustic signal of the heart and the ECG signal and analyze these signals.

Referring to FIG. **8**, the mobile device **801** displays the acoustic heart sound **803** and/or ECG signals **802** on the mobile device while recorded from the Sleeve. It captures, displays, and uploads patient information and the recorded signals to the backend server (encrypted). The mobile device displays heart sound analysis findings on the mobile device (in-time) or possible error messages generated by the back-end processing unit. It retrieves and display patient information from the back-end server on the mobile device. The user also saves and archives patient data, heart sound and/or ECG recordings on a back-end server (secure and encrypted), using the mobile device.

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FIG. **7** shows the interaction between the devices. For purposes of this disclosure, local computer **702** and mobile device **704** are defined to include all computing devices, whether portable or stationary. This definition includes, but is not limited to, electronic books, laptop and handheld computers, cellular phones, pagers, desktop computers, personal digital assistant (PDA), telehealth gateway or hub and wearable computers. The Sleeve **703** interconnects with the remote health server **701**. The Sleeve **703** may communicate with web applications running on the remote server **701** via the Internet or a private network **708**. The Sleeve may include cellular, WiFi other wireless or wired communication capability so as to interconnect with the server **701** either continuously or periodically. Communication with the remote server **701** may be via the local computer **702** or mobile device **704**. The Sleeve **703** may also include some type of memory chip or memory module that may be removed and inserted into the local computer **702** or the mobile device **044** for transfer of data. The Sleeve **703** may communicate with local computer **702** by interconnecting a wire between the computer **702** and the Sleeve **703**, or by "docking" the Sleeve **703** into a communications dock associated with computer **702**. The Sleeve **704** may also communicate with the computer **702** and a mobile device **74** by wireless communication **706**, **705**, such as infrared communication, Bluetooth and Zigbee or with a wired connection such as USB (Universal Serial Bus). The computer **702** and mobile device **704** communicates with the remote server **701** by cellular, WiFi other wireless or wired communications.

Referring to FIG. **15**, in another embodiment, the circumference of the sleeve **1505** contains at least one microphone **1502** (e.g., electret, Micro-electromechanical systems (MEMS) or microphone or piezoelectric transducer capable of low frequency response applied to body surface) used to record a body sounds. The circumference of the sleeve also contains a temperature sensor to record body temperature **1504**, and an accelerometer **1503**. In many embodiments, the accelerometer comprises at least one of a piezoelectric accelerometer, capacitive accelerometer or electromechanical accelerometer. The accelerometer **1503** may comprise a 3-axis accelerometer to measure at least one of an inclination, a position, an orientation or acceleration of the patient in three dimensions. Accelerometer can be used to provide respiration rate and blood flow for the patient. The above sensors have electrical leads attached to them, running along the body of the sleeve, coming together to form at least one electrical connector **1403**, **1405** in FIG. **14**. Any polymer or metal capable of being formed into a light weight, flexible sheet is suitable for the sleeve sensor. The preferred materials are polyolefin and silicon rubber. Useful polyolefins include polyethylene, polypropylene, polyvinyl chloride, and copolymers thereof. The sensor sleeve can also be made out of any other flexible and stretchable materials or a combination of flexible and rigid materials. The ECG electrodes are pieces of conductive material.

Referring to FIG. **10**, the user selects a new session, **1000** and creates **1001** or selects **1002** new patients using the custom software running on the client device. New patients are created by entering patient information such as Name, patient ID, Birth Date, Gender, Weight, Contact details, Session, Systolic blood pressure, Diastolic blood pressure and Height (this list is not intended to be exhaustive). Once a patient is selected user can start recording heart sound and or ECG **1003**. After recording, the results can be displayed **1004** to the user. User can go back to the main menu **1005** for recording option or review results.

FIG. 13 also teaches the aspect of creating a patient 1301, by entering patient information or details 1302, using a client device. Patient details are uploaded to patient database 108 in FIG. 1 at the backend server 113 in FIG. 1. Once patient details are uploaded, the patient is activated for selection 5 1304.

Referring to FIG. 11, the user goes to the process of recording 1001 physiological parameters (such as heart sound and/or ECG) by selecting or creating a patient. For heart sound, once a patient is selected, user selects auscultation location 1102 (Tricuspid, Aortic, Pulmonary, Apex(mitral)). User chooses patient posture by selecting Sitting, Standing or Supine. User also sets recording duration (e.g., 10 to 30 seconds). Then, user records at least hearts sounds and ECG 1003. In this case, the user is a health care worker or physician. Continuous streaming heart sounds and or ECG from the Sleeve (Bluetooth) is enabled when user taps onto the auscultation spot 804 in FIG. 8 (Aortic, Pulmonary, Tricuspid and Mitral), illustrated by a chest on the application, and initiate the recording for that particular position. The user can tap on the same position to discard the recording. Results are uploaded to server for analysis 1104. After analysis, results are available 1105 and transmitted to the client device.

Referring to FIG. 12, the user selects view a recording session 1201 by selecting a patient 1202, selects a location 1203 and retrieve the data or recorded results 1204. Results are output on headphones or speakers with sound quality Playback 1205 controls such as Start, Stop, Pause and-Volume. For ECGs, distance measurements between two points in milliseconds can be calculated such as Q-T intervals, using on-screen caliper tools. At this point, user can go back to the main menu or 1206 or re-record 1208 or replace the recording 1207.

In yet another embodiment, FIG. 16 refers to the sensor sleeve 1602, attached to a processing module (referred to as enclosure box (EB)) 1601. The EB contains electronics circuitry that comprises a processor and the corresponding circuitries for biosensor parameters similar to FIG. 5. The Sleeve 1202 is attached to the EB 1601 via an electrical connector 1603. The connector can be standard or micro Universal Serial Bus (USB). The standard USB can be a 2.0 Standard-A type of USB plug, a flattened rectangle which inserts into a "downstream-port" receptacle on the USB host that carries both power and data.

What is claimed is:

1. A method of determining an acoustic and electrical footprint of the heart comprising:

- a. Configuring a stethoscope front-end recorder sleeve device with biological sensors to acquire body sounds and electrocardiogram signals, wherein the sleeve further comprises a processor and wireless module;
- b. Wirelessly transmitting the heart sounds and the electrocardiogram signals to a mobile device, using the processor and the wireless module;
- c. Using the Mobile device, transmitting the heart sounds and the electrocardiogram signals to a remote server, wherein the remote server analyzes both the heart sounds and the electrocardiogram signals and determines cardiac malfunction;

- d. Using the remote server, transmitting the results of the analysis to the mobile device and archiving the results after transmission;
  - e. Displaying the result of the analysis on the mobile device.
2. The method according to claim 1, wherein the wireless transmission is Bluetooth.
  3. The method according to claim 1, wherein normal and pathological heart sounds are determined.
  4. The method according to claim 1 wherein the mobile device is a cellular telephone.
  5. The method according to claim 1 wherein the mobile device is a tablet computer.
  6. A system for determining normal and pathological heart sound comprising:
    - a. A stethoscope front-end recorder sleeve device with biological sensors, wherein the front-end recorder sleeve device is configured to:
      - i. Acquire at least body sounds and electrocardiogram signals;
      - ii. Transmit the body sounds and electrocardiogram signals to a client device;
      - iii. Display data transmission and battery life status;
    - b. The client device configured to:
      - i. Display the body sounds and electrocardiogram signals;
      - ii. Enable a user to create or select patients;
      - iii. Enable the user to select for body sound location and electrocardiogram leads;
      - iv. Record the body sounds, electrocardiogram signals and a cardiac index;
      - v. Enable the user to review the body sounds, electrocardiogram signals, and cardiac index;
      - vi. Transmit the body sounds and electrocardiogram signals to a remote server;
    - c. The remote server configured to:
      - i. Analyze the body sounds and electrocardiogram signals for normal and pathological conditions;
      - ii. Authenticate the user;
      - iii. Archive the body sounds, electrocardiogram signals, and cardiac index.
  7. The system according to claim 6, wherein the transmission of the body sounds and electrocardiogram signals to the client device is wireless.
  8. The system according to claim 7, wherein the wireless transmission is Bluetooth.
  9. The system according to claim 6, wherein the client device is a mobile phone.
  10. The system according to claim 6, wherein the client device is a laptop computer.
  11. The system according to claim 6, wherein the client device is a personal computer.
  12. The system according to claim 6, wherein the client device is a tablet computer.

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